38. Proposed by F. P. MATZ, D. Sc., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.

At what angle with the axis of a stalk must a *sharp* wedge-shaped blade be struck, in order to *sever* the stalk with the *least* force?

I. Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Applied Science, Texarkana College, Texarkana, Arkansas-Texas.

Let φ be the inclination of the axis of the stalk to the blade. A=area of of section made by blade, r=radius of stalk, and suppose resistance per unit of area to vary as $f(\varphi)$.

$\therefore$ R=resistance per unit of area$=mf(\varphi)$.

$\therefore$ $A=\pi r^2 \operatorname{cosec}\varphi$.

$\therefore$ Work of cutting any section is $\pi r^2 mf(\varphi)\operatorname{cosec}\varphi$. This may be made a minimum when $f(\varphi)$ is known.

II. Solution by O. W. ANTHONY, M. Sc., Professor of Mathematics and Astronomy, New Windsor College, New Windsor, Maryland.

Since the blade is *sharp* we may neglect the force required to cut through the fibres and only regard that required to produce longitudinal compression.

Call k the coefficient of longitudinal compression, θ the angle of the blade, and ϕ the angle which the lower surface of the blade makes with the horizontal. Then when the blade has just cut through the stalk the force upon each surface parallel to the axis of the stalk will be

$$dF=k[\tan(\phi+\theta)-\tan\phi]xydx.$$

Resolving these parallel to the surface of wedge and parallel to median line of wedge we have—

$$dF_1=k.\frac{\cos(\phi+\theta)+\cos\phi}{\sin\frac{\theta}{2}}(\tan(\phi+\theta)-\tan\phi)xydx,$$

where F_1 is the force perpendicular to base of wedge.

$$\text{Then } F_1=k.\frac{\cos(\phi+\theta)+\cos\phi)}{\sin\frac{\theta}{2}}[\tan(\phi+\theta)-\tan\phi]\int_0^{2a}xydx$$

$$=2k\cos\frac{\theta}{2}\Big[\sec(\phi+\theta)+\sec\phi\Big]\int_0^{2a}xydx.$$

$$\frac{dF_1}{d\phi}=0 \text{ for minimum.}$$

$\therefore$ $\sec(\phi+\theta)\tan(\phi+\theta)+\sec\phi\tan\phi=0$. By some obvious reductions

$$\sin(\phi+\frac{\theta}{2}).\{\cos^2(\phi+\frac{\theta}{2})+\sec^2\frac{\theta}{2}\}=0,$$

whence $\phi=-\frac{\theta}{2}$.

That is, the medial line is horizontal. The second factor gives imaginary results, except when $\theta=0$.

PROBLEMS.

39. **Proposed by B. F. FINKEL, A. M., Professor of Mathematics and Physics in Drury College, Springfield, Missouri.**

A person whose height is a and weight W stands in a swing whose length is l. Supposing the initial inclination of the swing to the vertical is α and that the person always crouches when in the highest position and stands up when in the lowest, his center of gravity moving through a distance b measured from lower part of swing upward, find how much the arc is increased after n complete vibrations.

40. **Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.**

Find the law of the force, in order that the orbit may be a Cassinian Oval.

41. **Proposed by O. W. ANTHONY, M. Sc., Professor of Mathematics and Astronomy, New Windsor College, New Windsor, Maryland.**

If the earth were a perfect sphere and had a frictionless surface, what would be the motion of a ball placed at a given latitude?

DIOPHANTINE ANALYSIS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

40. **Proposed by F. P. MATZ, D. Sc., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.**

The sum of three positive integral *cubic* roots of an equation is a square. What is the equation?

I. **Solution by E. L. SHERWOOD, A. M., Professor of Mathematics and Science in Mississippi Normal College, Houston, Mississippi.**

Let a, b, and c be the roots of the equation.

We then have $a^3+b^3+c^3=\square$.

This condition is satisfied by the equation $v^4(v^2+8v^2+27v^2)=\square$, where